WHAT IS CLAIMED IS:

1. A distributed optical amplifying apparatus, comprising:

an optical fiber having a middle field with a characteristic value which is larger than characteristic values of fields other than the middle field, the characteristic value of a respective field being a nonlinear refractive index of the optical fiber at the respective field divided by an effective cross section of the fiber at the respective field; and

a pump light source supplying pump light to the optical fiber.

2. The distributed optical amplifying apparatus according to claim 1, wherein a portion of the fiber having the middle field is connected to an adjacent portion of the fiber having a field other than the middle field by mode conversion splicing.

3. A distributed optical amplifying apparatus comprising:

a fiber line comprising first, second and third optical fibers connected together so that light travels through the fiber line from the first optical fiber, then through the second optical fiber and then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first characteristic value and the third characteristic value, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber; and

a pump light source supplying pump light to the fiber line.

4. The distributed optical amplifying apparatus according to claim 3, wherein the first and third characteristic values are almost equal.

5. The distributed optical amplifying apparatus according to claim 3, wherein a product of wavelength dispersion of the first optical fiber multiplied by wavelength dispersion of th second optical fiber is negative in a wavelength band of an optical signal transmitted through the fiber line, and wavelength dispersion of the third optical fiber is almost equal to that of the first optical fiber.

6. The distributed optical amplifying apparatus according to claim 5, wherein accumulated wavelength dispersion in a wavelength of the optical signal transmitted through the fiber line is almost zero at an output of the fiber line.

7. The distributed optical amplifying apparatus according to claim 3, wherein a product of a wavelength dispersion slope of the first optical fiber multiplied by a wavelength dispersion slope of the second optical fiber is negative in a wavelength band of an optical signal transmitted through the fiber line and a wavelength dispersion slope of the third optical fiber is almost equal to that of the first optical fiber.

8. The distributed optical amplifying apparatus according to claim 7, wherein an accumulated wavelength dispersion slope in a wavelength of the optical signal transmitted through the fiber line is in a linear shape relative to distance.

9. The distributed optical amplifying apparatus according to claim 7, wherein accumulated wavelength dispersion in a wavelength of the optical signal transmitted through the fiber line is almost zero at an output of the fiber line.

10. The distributed optical amplifying apparatus according to claim 3, wherein the first optical fiber and the third optical fiber are almost the same in length.

11. The distributed optical amplifying apparatus according to claim 3, wherein a ratio of a sum of a length of the first optical fiber and a length of the third optical fiber to a length of the second optical fiber is in the range of approximately 1:1 to approximately 2:1.

12. The distributed optical amplifying apparatus according to claim 3, wherein the fiber line is 50 km or more in length.

13. The distributed optical amplifying apparatus according to claim 3, wherein a relative gain of a Raman on/off gain relative to total loss of the fiber line is approximately 0.5 up to 1.

14. A distributed optical amplifying apparatus comprising:

a fiber line comprising first, second and third optical fibers connected together so that light traveling through the fiber line travels through the first optical fiber, then through the second optical fiber, and then through the third optical fiber; and

a pump light source supplying pump light to the fiber line, wherein

a value $D1/S1$ of a wavelength dispersion coefficient D1 of the first optical fiber divided by a wavelength dispersion slope S1 thereof is almost equal to a value $D2/S2$ of a wavelength dispersion coefficient D2 of the second optical fiber divided by a wavelength dispersion slope S2 thereof, and

a sum of a value $D1 \cdot L1$ of the wavelength dispersion coefficient D1of the first optical fiber multiplied by a length L1 thereof and a value of the wavelength dispersion coefficient D2 of the second optical fiber multiplied by a length L2 thereof is almost zero,

a wavelength dispersion coefficient, a wavelength dispersion slope, and a length of the third optical fiber are almost equal to the wavelength dispersion coefficient D1, the wavelength dispersion slope S1, and the length L1 of the first optical fiber,

accumulated wavelength dispersion in a wavelength of an optical signal transmitted through the fiber line is almost zero at an output of the fiber line, and

an accumulated wavelength dispersion slope in the wavelength of the optical signal transmitted through the fiber line is almost zero at the output of the fiber line.

15. An optical communication station comprising:

processing means for performing predetermined processing for an optical signal;

a fiber line connected to said processing means and comprising first, second and third optical fibers connected together so that the optical signal travels through the fiber line by traveling through the first optical fiber, then through the second optical fiber, and then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first and third characteristic values, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber; and

a pump light source supplying pump light to the fiber line.

16. The optical communication station according to claim 15, wherein said processing means is receiving means for receiving the optical signal.

17. The optical communication station according to claim 15, wherein said processing means is repeating/amplifying means for amplifying the optical signal.

18. The optical communication station according to claim 15, wherein said processing

means is dropping/adding means for dropping and/or adding an optical signal with a predetermined wavelength from/to a wavelength-division multiplexing optical signal in which wavelengths of a plural of optical signals with different wavelengths from each other are multiplexed.

19. An optical communication system comprising:

an optical transmission line;

first and second stations connected together through the optical transmission line and performing predetermined processing of an optical signal transmitted through the optical transmission line, and

a pump light source supplying pump light to the transmission line,

wherein the transmission line comprises first, second and third optical fibers connected together so that the optical signal travels through the transmission line by traveling through the first optical fiber, then through the second optical fiber, and then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first and third characteristic values, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber.

20. An optical communication system comprising:

first and second transmission lines, each having first and second ends;

an optical transmitting station generating an optical signal and providing the generated optical signal to the first end of the first transmission line so that the optical signal travels through the first transmission line to the second end of the first transmission line;

an optical repeater station receiving the optical signal from the second end of the first transmission line, amplifying the received optical signal, and providing the amplifying optical signal to the first end of the second transmission line so that the amplified optical signal travels through the second transmission line to the second end of the second transmission line; and

an optical receiving station receiving the amplified optical signal from the second end of the second optical transmission line, wherein at least one of the first and second transmission lines comprises

first, second and third optical fibers connected together so that the optical signal travels through the respective transmission line by traveling through the first optical fiber, then through the second optical fiber, and then through the third optical fiber, the first, second and third optical fibers

having first, second and third characteristic values, respectively, the second characteristic value being larger than the first and third characteristic values, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber, pump light source being providing to the respective transmission line.

21. The optical communication system according to claim 20, wherein the optical repeater station comprises dropping/adding means for dropping and/or adding a predetermined optical signal from/to a wavelength-division multiplexing optical signal in which wavelengths of a plural of optical signals with different wavelengths from each other are multiplexed.

22. An apparatus comprising:

an optical fiber cable comprising a plurality of optical fibers, each optical fiber having a characteristic value in a middle field which is larger than characteristic values in fields other than the middle field of the optical fiber, the characteristic value in a respective field being a nonlinear refractive index of the optical fiber in the field divided by an effective cross section of the optical fiber in the field.

23. An apparatus comprising:

an optical fiber cable comprising first, second and third optical fibers connected together so that light traveling through the cable travels through the first optical fiber, then through the second optical fiber and then through the third optical fiber, the second optical fiber having a negative dispersion value, the first and third optical fibers each having a positive dispersion value, the cable optically connecting together two optical repeater stations, or an optical repeater station and an end station.

24. The apparatus according to claim 23, wherein the first and third optical fibers each have zero dispersion values in 1.3 μm bands.

25. An optical communication system comprising:

an optical fiber cable comprising first, second and third optical fibers connected together so that light traveling through the cable travels through the first optical fiber, then through the second optical fiber and then through the third optical fiber, the second optical fiber having a negative dispersion value, the first and third optical fibers each having a positive dispersion value, the cable

optically connecting together two optical repeater stations with one of the optical repeater stations providing pump light to the cable so that distributed Raman amplification occurs in the cable, or the cable optically connecting together an optical repeater station and an end station so that one of the optical repeater station and the end station provides pump light to the cable so that distributed Raman amplification occurs in the cable.

26. The optical communication system according to claim 25, wherein the first and third optical fibers have zero dispersion values in 1.3 μ bands.

27. An apparatus comprising:

a transmission line comprising first, second and third optical fibers connected together from an input end to an output end of the transmission line so that a signal light travels through the input end, then through the first optical fiber, then through the second optical fiber, then through the third optical fiber and then through the output end, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first characteristic value and the third characteristic value, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber; and

a pump light source supplying pump light to the transmission line so that the signal light is amplified by Raman amplification as the signal light travels through the transmission line.

28. The apparatus according to claim 27, wherein the first and third characteristic values are almost equal.

29. The apparatus according to claim 27, wherein a product of wavelength dispersion of the first optical fiber multiplied by wavelength dispersion of the second optical fiber is negative in a wavelength band of the signal light, and wavelength dispersion of the third optical fiber is almost equal to that of the first optical fiber.

30. The apparatus according to claim 29, wherein accumulated wavelength dispersion in a wavelength of the signal light is almost zero at the output end of the transmission line.

31. The apparatus according to claim 27, wherein a product of a wavelength

dispersion slope of the first optical fiber multiplied by a wavelength dispersion slope of the second optical fiber is negative in a wavelength band of the signal light and a wavelength dispersion slope of the third optical fiber is almost equal to that of the first optical fiber.

32. The apparatus according to claim 31, wherein an accumulated wavelength dispersion slope in a wavelength of the signal light traveling through the transmission line is in a linear shape relative to distance.

33. The apparatus according to claim 31, wherein accumulated wavelength dispersion in a wavelength of the signal light is almost zero at the output end of the transmission line.

34. The apparatus according to claim 27, wherein the first optical fiber and the third optical fiber are almost the same in length.

35. The apparatus according to claim 27, wherein a ratio of a sum of a length of the first optical fiber and a length of the third optical fiber to a length of the second optical fiber is in the range of approximately 1:1 to approximately 2:1.

36. The apparatus according to claim 27, wherein the transmission line is 50 km or more in length.

37. The apparatus according to claim 27, wherein a relative gain of a Raman on/off gain relative to total loss of the transmission line is approximately 0.5 up to 1.

38. An apparatus comprising:

a transmission line comprising first, second and third optical fibers connected together from an input end to an output end of the transmission line so that a signal light travels through the input end, then through the first optical fiber, then through the second optical fiber, then through the third optical fiber and then through the output end; and

a pump light source supplying pump light to the transmission line so that the signal light is amplified by Raman amplification as the signal light travels through the transmission line, wherein

a value D1/S1 of a wavelength dispersion coefficient D1 of the first optical fiber divided by a wavelength dispersion slope S1 thereof is almost equal to a value D2/S2 of a

wavelength dispersion coefficient D2 of the second optical fiber divided by a wavelength dispersion slope S2 thereof, and

a sum of a value D1•L1 of the wavelength dispersion coefficient D1of the first optical fiber multiplied by a length L1 thereof and a value of the wavelength dispersion coefficient D2 of the second optical fiber multiplied by a length L2 thereof is almost zero,

a wavelength dispersion coefficient, a wavelength dispersion slope, and a length of the third optical fiber are almost equal to the wavelength dispersion coefficient D1, the wavelength dispersion slope S1, and the length L1 of the first optical fiber,

accumulated wavelength dispersion in a wavelength of the signal light is almost zero at the output end of the transmission line, and

an accumulated wavelength dispersion slope in the wavelength of the signal light is almost zero at the output end of the transmission line.

39. An optical communication system comprising:

an optical transmission line;

first and second stations connected together through the optical transmission line and performing predetermined processing of a signal light transmitted through the transmission line, and

a pump light source supplying pump light to the transmission line so that the signal light is amplified by Raman amplification as the signal light travels through the transmission line,

wherein the transmission line comprises first, second and third optical fibers connected together so that the optical signal travels through the transmission line by traveling through the first optical fiber, then through the second optical fiber, and then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first and third characteristic values, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber.

40. An optical communication system comprising:

first and second transmission lines, each having first and second ends;

an optical transmitting station generating an optical signal and providing the generated optical signal to the first end of the first transmission line so that the optical signal travels through the first transmission line to the second end of the first transmission line;

an optical repeater station receiving the optical signal from the second end of the first

transmission line, amplifying the received optical signal, and providing the amplifying optical signal to the first end of the second transmission line so that the amplified optical signal travels through the second transmission line to the second end of the second transmission line; and

an optical receiving station receiving the amplified optical signal from the second end of the second optical transmission line, wherein at least one of the first and second transmission lines comprises

first, second and third optical fibers connected together so that the optical signal travels through the respective transmission line by traveling through the first optical fiber, then through the second optical fiber, and then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first and third characteristic values, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber, pump light being supplied to the respective transmission line so that the optical signal is amplified by Raman amplification as the optical signal travels through the respective transmission line.

41. The optical communication system according to claim 40, wherein the optical repeater station comprises dropping/adding means for dropping and/or adding a predetermined optical signal from/to a wavelength-division multiplexing optical signal in which wavelengths of a plural of optical signals with different wavelengths from each other are multiplexed.

42. An apparatus comprising:

a transmission line comprising first, second and third optical fibers, the first optical fiber being connected to the second optical fiber and the second optical fiber being connected to the third optical fiber so that a signal light traveling through the transmission line travels through the first optical fiber, then through the second optical fiber, then through the third optical fiber, the first, second and third optical fibers having first, second and third characteristic values, respectively, the second characteristic value being larger than the first characteristic value and the third characteristic value, the characteristic value of a respective optical fiber being a nonlinear refractive index of the optical fiber divided by an effective cross section of the optical fiber; and

a pump light source supplying pump light to the transmission line so that the signal light is amplified by Raman amplification as the signal light travels through at least one of the first, second and third optical fibers.